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International Insurance Services

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Abstract

We examine foreign firm participation in national insurance markets. We explain how a structural model of mode 3 international trade in services with firm heterogeneity can provide a simple formula for estimating differences in the costs of market entry facing foreign and domestic firms in each country. When the formula is applied to OECD and Eurostat data for the insurance industry for many national markets, the implied relative fixed costs vary significantly across countries, though in the majority of countries these fixed costs are lower for foreign firms rather than domestic firms. The results suggest that the foreign firms typically benefit from multi-country economies of scale that more than offset barriers to entry.

Modeling International Insurance Services

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Office of Industries and Office of Economics
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Introduction

Insurance companies commonly sell their services across borders, most frequently through foreign affiliates that have established a local commercial presence. In OECD and select non-OECD countries in 2016, foreign-owned companies and branches of foreign companies accounted for approximately 40 percent of gross insurance premiums in both the life and non-life insurance segments. Foreign suppliers' market share varied significantly across countries, ranging from 0 to 100 percent of total domestic insurance business across both segments.[1]

In this paper, we modify a model of international trade with firm heterogeneity from Helpman, Melitz, and Yeaple (2004) to better fit the insurance services industry, where local commercial presence is by far the dominant mode of international supply. We estimate the differences in the costs of market entry for domestic and foreign firms using the model and available industry data on the numbers and revenues of foreign and domestic firms in each country. We define fixed costs as the incremental overhead costs associated with participating in the national market (these are costs that are only incurred if the firm sells in the national market, and that do not increase with the firm's volumes of sales in the national market). We use data on the value of sales and the number of firms in the market to calculate the average scale of foreign and domestic firms in each country. According to the model, the ratio of the scale of these two types of firms is equal to the ratio of their fixed costs of national market participation under the assumptions of the model.

We find that there is substantial variation in this ratio across countries, but in most cases the implied fixed costs of domestic firms are larger than those of foreign firms in the same national market. We expect that foreign firms face higher, discriminatory barriers to entry in many countries, based on

[1] OECD, Insurance Statistics Database (accessed various dates).

evidence from services trade restrictiveness indices. But the data, when interpreted with the simplest version of the model with separate fixed costs for each national market, indicate lower fixed costs for foreign firms. We can reconcile the model with the data with a small adjustment of the theory's simplifying assumption that fixed costs are separate and specific for each national market. If firms entering overseas markets can leverage some of the overhead costs that they incur in their home markets and achieve multi-country economies of scale, then the model better fits the data. The mismatch of the data to the simplest version of the model may also indicate limitations of the data. For example, the model assumes that each firm sells only one variety (type of service). In reality, however, firms offer complex combinations of services. This is potentially a significant data issue.

The rest of the paper is organized into five sections. Section 2 provides a brief overview of the insurance industry. Section 3 describes OECD and Eurostat data on the insurance industry. Section 4 discusses the relative fixed costs of foreign firms implied by the data analysis, and Section 5 concludes.

Insurance Industry

The global insurance industry, measured by direct premiums written, was valued at $4,732 billion in 2016.[2] The largest insurance market was the United States, with 25.6 percent of total world premiums in 2016, followed by Japan and China (approximately 10 percent each), and the United Kingdom and France (approximately 6 and 5 percent, respectively). The life insurance portion of the industry accounted for approximately 55 percent of the global total ($2,617 billion), while the non-life segment accounted for roughly 45 percent ($2,115 billion).[3] These statistics do not reflect any potential

[2] Swiss Re, "World insurance in 2016," 45-55. Insurance Information Institute, *2018 Insurance Factbook*, 1. Direct premiums do not include premiums written for reinsurance.
[3] Although countries may vary in how they classify sub-categories of insurance services, these statistics incorporate accident and health insurance in the non-life segment.

premiums that are ceded between companies—a portion of the industry that is referred to as reinsurance.

In the United States, the insurance market is divided into two segments: property-casualty and life insurance. These segments differ from the global life and non-life segments in that the U.S. life insurance segment includes accident and health insurance, while accident/health coverage is captured in the global non-life segment. U.S. non-life insurance is referred to as property-casualty insurance and is divided into personal and commercial insurance. In the personal segment, auto and homeowners insurance are the largest categories. In the commercial segment, workers compensation is the largest line of insurance.[4] In the U.S. life insurance segment, annuities are the largest category, comprising almost half of the direct premiums written in 2016, followed by accident and health insurance and life insurance.[5]

Data on trade in insurance services correspond to the W/120 Services Sectoral Classification definition of the sector, and include life insurance, non-life insurance, reinsurance, and auxiliary services. Insurance services are predominantly provided through a commercial presence (or Mode 3) in foreign markets.[6] In 2015, U.S. cross-border exports of insurance services ($16.2 billion) were approximately a quarter of U.S.-owned foreign affiliate sales ($64.9 billion). In the same year, U.S. cross-border imports of insurance services ($47.8 billion) were approximately three-fourths of foreign-owned U.S. affiliate purchases ($64.4 billion).[7]

[4] Insurance Information Institute, *2018 Insurance Factbook*, 71-72. These are measured as net premiums.
[5] Insurance Information Institute, *2018 Insurance Factbook*, 48. These are measured as direct premiums. See page 49 of the *Factbook* for more statistics and information on health insurance.
[6] OECD, "STRI Sector Brief: Insurance," 2017. Certain types of insurance are predominantly provided through cross-border trade, including "large-scale commercial transactions, reinsurance and marine, aviation and transport insurance."
[7] USDOC, BEA, U.S. International Services Tables, tables 2.1, 4.1, and 5.1, October 24, 2017.

The predominance of Mode 3 provision of insurance services reflects regulatory requirements to provide most types of insurance services (i.e., direct/personal) through a local presence and the importance of the agent-client relationship in the insurance industry. In maintaining operations abroad, foreign firms face various costs. While the remainder of this section focuses on regulatory costs, firms also face administrative costs of maintaining a presence in foreign markets.

The OECD Services Trade Restrictiveness Index (STRI) quantifies information on laws and regulations affecting international trade in insurance services in OECD member countries and select non-OECD countries as of 2017. Among the 44 countries for which OECD STRI data are available, foreign equity caps specific to insurance services are not prevalent (only maintained in China, Indonesia, India, and Russia).[8] However, over a third of the countries have some form of restriction on firms' ability to establish branches (which are frequently regulated separately for the life, non-life, and reinsurance portions of the industry). According to the OECD STRI, these restrictions take many forms. For example, Indonesia and Russia prohibit branches for all types of insurance segments while India only allows foreign reinsurers to operate branches. Further, according to the OECD STRI, almost a third of the countries impose discriminatory licensing criteria on foreign firms. Price restrictions and prior approval requirements are prevalent across countries and act as barriers for foreign firms.

Finally, the OECD STRI reports that many countries maintain conditions on cross-border data flows or force the localization of data, which likely impact insurance firms. For example, China and Russia require that personal data be stored locally and China has additional conditions on the subsequent transfer of data. Companies processing the personal data of EU residents must comply with the new EU General Data Protection Regulation (and the previous EU Data Protection Directive).

[8] OECD, Services Trade Restrictiveness Index.

OECD and Eurostat Data for the Insurance Industry

We use two sources of data on the global insurance industry: OECD and Eurostat. The OECD maintains a series of statistics that are specific to the insurance industry. The data are available for OECD countries and select non-OECD countries, reported for various segments of the insurance industry, by different types of premiums, and separately for domestic companies, foreign-owned companies, and branches of foreign companies. In the main analysis we use OECD data and focus on the differences in total gross premiums between domestic firms on one hand and foreign-owned companies and branches on the other. These data also allow us to replicate the analysis (reported in the appendix) on net premiums and on the two types of foreign entities. Eurostat maintains a database specific to EU enterprises. Statistics reported by Eurostat include the activity and characteristics of EU enterprises (differentiated by country of enterprise ownership) across multiple industries including insurance. In the main analysis we use Eurostat data in focusing on the differences between foreign and domestic firms, and in a secondary analysis we distinguish between EU and non-EU owned foreign firms.

OECD

Within OECD's Insurance Statistics, we use the datasets that report statistics on premiums ("Business written in the reporting country") and on number of companies ("Number of insurance undertakings").[9] The statistics on premiums are available as (i) total gross premiums (sum of direct business and reinsurance accepted), which are used in the main analysis; (ii) net premiums (total gross premiums less premiums ceded), which reflect premiums retained in each reporting country and are used in a

[9] OECD, Insurance Statistics Database (accessed various dates).

secondary analysis reported in the appendix; and (iii) premiums ceded, including reinsurance and retrocession.[10]

Data on both premiums and number of companies are reported separately for domestic companies, foreign-controlled companies, and branches and agencies of foreign companies. OECD defines each as follows:

1. Domestic companies: "companies incorporated under national law, together with those companies in the reporting country which are unincorporated, but excluding the branches and agencies of foreign companies."
2. Foreign-controlled companies: "domestic companies controlled by foreign interests, such "control" being defined according to national laws. The data of foreign-controlled companies are part of those of domestic companies."
3. Foreign companies: "companies incorporated outside the reporting country."

Because foreign-controlled companies are a subset of domestic companies, we subtract their data from that of domestic company totals and add them to data on branches and agencies of foreign companies. This calculation isolates domestic companies and aggregates the two types of foreign companies into one foreign total. Although our main analysis reports scale (gross premiums/number of companies) for domestic and aggregated foreign companies, our secondary analysis in the appendix reports the average scale of each type of firm (domestic companies, aggregated foreign companies, foreign-controlled companies, and branches and agencies of foreign companies).

[10] Retrocession refers to the reinsurance of reinsurance.

Eurostat

From Eurostat's Structural Business Statistics database, we use data on "Foreign controlled EU enterprises – inward Foreign Affiliate Statistics (or FATS)."[11] These include statistics on various characteristics (such as number of employees) and activities (such as revenue) of foreign affiliates resident in each compiling economy across different industries by the NACE Rev.2 classifications.

We use data on NACE Rev.2 category K65: "Insurance, reinsurance and pension funding, except compulsory social security."[12] The analysis employs data on gross premiums written[13] and number of enterprises, which are presented by controlling country or region. We use gross premiums/number of enterprises as reported for the "world total except the reporting country" (to calculate average gross premiums per foreign firm) and "reporting country" (to calculate average gross premiums per domestic per firm). We also use the data to distinguish foreign firms that are controlled by countries outside the EU (Extra-EU 28) from those are controlled by countries inside the EU (Intra-EU 28).

Implied Relative Fixed Costs

The analysis and calculations in this section are based on an economic model of sales of insurance services by domestic firms and affiliates of foreign firms (see appendix). The model is a partial equilibrium version of the model of international trade with firm heterogeneity and foreign affiliate sales in Helpman, Melitz, and Yeaple (2004).

[11] Eurostat, Foreign Control of Enterprises by Economic Activity and a Selection of Controlling Countries (from 2008 onwards)," (accessed various dates). For information on the data, see http://ec.europa.eu/eurostat/cache/metadata/en/fats_esms.htm.

[12] Data on NACE Rev. 2 category K66 "Activities auxiliary to financial services and insurance activities" is not included in the analysis.

[13] The data are reported across industries as "turnover or gross premiums written." In this case, since the data are specific to the insurance industry, we assume it refers to gross premiums.

According to the model, the ratio of sales per foreign firm to sales per domestic firms, which we call the relative scale of the foreign firms, is simply equal to the ratio of their fixed costs. In this section, we use the relative scale of foreign firms to impute the ratio of fixed costs of participating in each national market. The model implies that foreign firms will have larger scale in the national market than domestic firms if they face larger fixed costs of participating in the market, and vice versa. It may seem counter-intuitive that larger costs could lead to larger scale, but it is a result of the zero-profit condition for market entry of the marginal firm at the cutoff: a firm facing a larger fixed cost will have to sell more in the market to break even.

If overhead costs are independent across national markets, with no multi-country economies of scale (as in Melitz models), then the ratio of the fixed costs of participating in the national market can serve as a measure of discriminatory costs or barriers to foreign firm participation in the market. In this case, we would expect that the ratio of foreign fixed costs to domestic fixed costs would be generally *greater than one*.

If firms entering overseas markets can leverage some of the overhead costs that they incur in their home markets, so that there are multi-country economies of scale, then the modeling framework could also explain cases where the ratio of foreign fixed costs to domestic fixed costs of participating in the national market is less than one. In these cases, however, the ratio no longer isolates and measures the discriminatory costs of barrier to foreign firm participation in the market.

Table 1 applies the ratio calculation discussed above to OECD statistics for the insurance industry. The table reports average gross premiums per firm, separately for domestic firms and foreign firms. For 10 of the 30 countries in table 1, gross premiums per firm are higher for foreign firms than for domestic firms (yielding a ratio in the last column in table 1 of greater than one). For 20 of the 30 countries, gross premiums per firm are higher for domestic firms than foreign firms, implying that foreign firms face

lower fixed costs of participating in the market and suggesting that the foreign firms benefit from multi-country economics of scale.

Table 1: Estimates based on OECD Data

National Market	Year	Average Gross Premiums per Foreign Firm (Million US Dollars)	Average Gross Premiums per Domestic Firm (Million US Dollars)	Implied Ratio of Fixed Costs
Argentina	2016	107.5	65.4	1.6
Australia	2016	257.3	825.5	0.3
Austria	2016	429.2	614.6	0.7
Brazil	2016	73.2	626.2	0.1
Canada	2015	197.6	827.0	0.2
Costa Rica	2016	23.3	477.8	0.0
Czech Republic	2016	135.0	38.9	3.5
Estonia	2016	56.1	9.9	5.6
Germany	2016	1271.3	740.4	1.7
Greece	2016	136.8	50.2	2.7
Honduras	2015	33.0	39.9	0.8
Italy	2016	326.1	1641.2	0.2
Japan	2016	1738.3	6893.4	0.3
Korea	2016	679.8	5576.4	0.1
Latvia	2016	29.6	35.8	0.8
Lithuania	2016	40.8	51.1	7.9
Luxembourg	2016	57.5	157.9	0.4
Malaysia	2016	332.2	200.0	1.7
Norway	2015	169.9	237.7	0.7
Paraguay	2016	28.5	9.1	3.1
Portugal	2016	169.6	147.3	1.2
Russia	2016	62.5	63.6	1.0
Singapore	2016	159.9	322.2	0.5
Slovak Republic	2015	60.7	107.0	0.6
Spain	2016	360.0	257.2	1.4
Switzerland	2016	247.2	395.2	0.6
Turkey	2016	208.3	258.9	0.8
United Kingdom	2015	682.6	767.3	0.9
United States	2016	598.6	654.9	0.9
Uruguay	2015	37.7	215.8	0.2

Because firms are able to draw on profits earned in their home country or across other countries where they may have a presence, one implication of multi-country economies of scale is foreign firms' willingness to participate in markets where they are relatively less profitable or unprofitable. There may

be more than one reason why a firm would be unprofitable. For example, insurance firms may be unprofitable when first beginning to operate abroad or may choose to operate at a loss in order to retain a large client that wants to work with an insurer with offices in each of the markets in which that client has a presence.

Another possible explanation for the ratios in table 1 is that participation in the market may not be determined by monopolistic competition and a zero profit condition, as the model assumes. A smaller number of domestic firms operating at larger scale than their foreign competitors could reflect historical barriers to entry or greater industry consolidations due to other restrictions on competition.

Finally, the data may simply be a poor match for the model if the foreign firms have fewer product lines than their domestic counterparts. They could have larger scale per product line, implying relatively high fixed costs, but still have lower total scale per firm, whether there are multi-country scale economies or not. This may occur, for example, with branches in foreign markets.

As a preliminary way to explore these possibilities, we replicate the analysis in two ways. First, in place of gross premiums, we focus on net premiums which are defined as total gross premiums less premiums ceded (for reinsurance and retrocession).[14] Focusing on net premiums allows us to remove the cross-border portion of reinsurance —and likely most cross-border insurance, since reinsurance accounts for the bulk of cross-border insurance trade — and to isolate the domestic segment of the industry, in line with the model's focus on Mode 3 supply. The results of the analysis reported in the appendix tables

[14] The OECD also reports data on direct premiums, which are total gross premiums less reinsurance accepted. These relationships imply that net premiums include direct premiums and premiums from reinsurance accepted, less premiums ceded. One difference between premiums ceded and reinsurance accepted is with respect to cross-border activities with reinsurance accepted referring to premiums from reinsurance accepted within the reporting country while premiums ceded may be ceded to reinsurers abroad. OECD representative, email messages to USITC staff, various dates March – May, 2018.

remain similar to the results reported in table 1, with the exception of Estonia which does not have adequate data.

Second, we distinguish between the two types of foreign firms that are reported in the OECD data: foreign controlled firms and branches and agencies of foreign companies incorporated outside the reporting country. As the appendix tables show, the average scale for foreign controlled firms tends to be higher than that of foreign branches and agencies. Consequently, in 15 of the 29 observations, foreign controlled firms have a higher average scale relative to domestic firms, while foreign branches and agencies have a higher scale in only 2 of the observations. The relatively limited output of branches and agencies (compared to domestic firms and foreign controlled firms) could be due to reasons cited above, including regulatory restrictions on branch activity or insurance company structures, where certain foreign operations include smaller-scale branches that do not reflect the overall scale of the company.

Table 2 reapplies the formula from the model to the insurance industry data from Eurostat. For these data, we calculate gross premiums per firm separately for domestic and foreign firms in the 15 EU countries with available data. For 9 of the 15 EU countries in table 2, gross premiums per firm are higher for foreign firms than for domestic firms (yielding a ratio in the last column of greater than one).

Table 2: Estimates based on Eurostat Data

National Market	Year	Gross premiums per Foreign Firm (Million Euros)	Gross premiums per Domestic Firm (Million Euros)	Implied Ratio of Fixed Costs
Czech Republic	2015	137.3	10.9	12.6
Greece	2014	78.3	45.9	1.7
Spain	2015	45.4	55.5	0.8
France	2015	999.9	849.9	1.2
Cyprus	2015	28.8	43.5	0.7
Latvia	2014	27.5	38.5	0.7
Lithuania	2015	56.1	16.4	3.4
Hungary	2013	105.6	6.5	16.3
Netherlands	2015	191.6	99.3	1.9
Austria	2015	343.2	395.5	0.9
Portugal	2015	118.2	175.1	0.7
Romania	2015	56.4	20.0	2.8
Slovakia	2014	51.6	2.0	25.6
Finland	2014	0.1	0.7	0.2
United Kingdom	2014	545.0	475.7	1.1

Finally, table 3 reapplies the formula to insurance industry data from Eurostat that distinguishes foreign firms that are controlled by countries outside the EU from those are controlled by countries inside the EU. We calculate gross premiums per firm for these two categories of firms in nine EU countries with available data. We would expect non-EU owned foreign firms to higher relative fixed costs than EU-owned foreign firms. However, in only 3 of the 9 countries in table 3, gross premiums per firm are higher for non-EU foreign owned firms than for foreign firms from other EU countries.

Table 3: Estimates for EU and Non-EU Foreign Firms

National Market	Year	Gross premiums per Non-EU Foreign Firm (Million Euros)	Gross premiums per EU Foreign Firm (Million Euros)	Implied Ratio of Fixed Costs
Czech Republic	2015	25.3	146.2	0.2
Germany	2014	212.7	433.9	0.5
Spain	2015	259.2	34.7	7.5
France	2015	403.2	1230.9	0.3
Cyprus	2014	13.6	35.4	0.4
Austria	2015	273.6	359.5	0.8
Portugal	2015	195.2	90.1	2.2
Romania	2015	22.4	60.4	0.4
United Kingdom	2014	552.4	528.8	1.0

Conclusions

In principle, the modified Helpman, Melitz, and Yeaple model provides a formula for estimating the differences in the barriers or costs of market entry facing foreign and domestic firms in each country. When the formula is applied to OECD and Eurostat data for the insurance industry in many different countries, the implied relative fixed costs vary significantly across the countries (and across the data sources), though in the majority of the countries implied fixed costs are lower for foreign firms than for domestic firms. The lower incremental fixed costs of market entry for foreign firms does not fit the simplest version of the model but can be explained with minor modifications of the model, in which the foreign firms benefit from multi-country economies of scale. Still, there is no question that testing and further refining the modeling of international insurance services would benefit from more detailed data.

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Appendix

Economic Model with Foreign Affiliate Sales and Fixed Costs of Market Entry

In this section, we derive an economic model of sales of insurance services by domestic firms and affiliates of foreign firms. The model is a partial equilibrium version of the model of international trade with firm heterogeneity and foreign affiliate sales in Helpman, Melitz, and Yeaple (2004).

The model focuses on sales of insurance in a single national market. Firms provide services that are differentiated from other firms in the market, and they engage in monopolistic competition. The parameter $\varepsilon > 1$ is the constant elasticity of substitution among the firms' varieties.

To simplify the model, we assume that foreign firms only supply the national market through local affiliates. There are n_A foreign firms active in the market, out of N_A potentially active firms.[15] There are n_D domestic firms active in the market, out of N_D potentially active firms.

There are many inputs into production, including technology, physical capital, financial capital, and labor, and they are combined in fixed proportions.[16] The cost of each unit of composite input is c. Firms vary in how productively they use the inputs. The unit input requirement of each firm, a, is drawn from a distribution with cumulative distribution function $G(a)$.[17] The productivity of individual firms has a Pareto distribution with shape parameter k.

Beyond the unit input requirement, each firm pays an overhead cost if the firm participates in the national market. We call this the fixed cost, because it does not increase with the volume of the firm's

[15] In the seminal model in Melitz (2003), the number of potentially active firms in each market depends on costly entry decisions that lead to random productivity draws, but the analysis in this paper it does not matter how the number of potentially active firms is determined, and this variable also does not have to be measured.
[16] In contrast, labor is the only factor of production in Helpman, Melitz, and Yeaple (2004).
[17] The reciprocal of the unit input requirement is the firm's productivity.

sales in the national market. For foreign firms, this may not be their overhead cost of all of their operations. It is simply their incremental overhead cost of participating in the national market in the model. Within the class of models based on Melitz (2003), including Helpman, Melitz, and Yeaple (2004), it is common to assume that the fixed costs are separate and specific to each national market. Under this standard assumption, the incremental overhead cost of entering a second or third market may be substantially lower than the fixed costs of entering a first market. The fixed cost of domestic firms is f_D, and the fixed cost of affiliates of foreign firms is f_A.

Each firm's profits in the national market are the difference between its revenue and costs of supplying services. Equation (1) represents the revenue of a domestic firm in the national market.

$$R_D(a) = \beta\, E P^{\varepsilon-1} p(a)^{1-\varepsilon} \quad (1)$$

The variable E represents aggregate expenditure in the national market, β is the constant expenditure share on insurance services in aggregate expenditure, P is a CES price index for insurance in the market, and $p(a)$ is the producer price of a firm with unit input requirement a.[18] Equation (2) is the marginal cost of supplying the service in the country.

$$m(a) = a\, w \quad (2)$$

The assumptions of CES demand and monopolistic competition imply that the producer price is set as a constant mark-up over the marginal costs.

[18] The Helpman, Melitz, and Yeaple framework assumes that there are constant expenditure shares, corresponding to Cobb-Douglas preferences across categories of services.

$$p(a) = \left(\frac{\varepsilon}{\varepsilon - 1}\right) m(a)$$

(3)

Since all firms in the market produce the service locally, they face the same unit input price, and so the only difference in their costs of providing the service is their productivity.

Combining these elements, equation (4) represents the profits of a domestic firm with unit input requirement a.

$$\pi_D(a) = \frac{1}{\varepsilon}\ \beta\ E P^{\varepsilon-1} \left(\frac{\varepsilon}{\varepsilon - 1}\right) a\ w^{1-\varepsilon} - f_D$$

(4)

All domestic firms with unit input requirements below a cutoff level a_D sell in the national market. The cutoff level is implicitly defined in equation (5).

$$\pi_D(a_D) = 0$$

(5)

Equation (6) is the profits of a foreign firm with unit input requirement a.

$$\pi_A(a) = \frac{1}{\varepsilon}\ \beta\ E\ P^{\varepsilon-1} \left(\frac{\varepsilon}{\varepsilon - 1}\right) a\ w^{1-\varepsilon} -\ f_A$$

(6)

Foreign firms with unit input requirements below a cutoff level a_A sell in the market by establishing a foreign affiliate. This cutoff level is implicitly defined in equation (7).

$$\pi_A(a_A) = 0$$

(7)

Equations (4) through (7) imply that the relative cutoff level depends on the relative fixed costs of participating in the national market.[19]

$$h = \frac{a_A}{a_D} = \left(\frac{f_A}{f_D}\right)^{\frac{1}{1-\varepsilon}}$$

(8)

Equations (9) and (10) represent the equilibrium values of domestic and foreign affiliate sales (v_D and v_A) associated with the cutoff unit input requirements.

$$v_D = N_D\ \beta\ E\ P^{\varepsilon-1}\left(\left(\frac{\varepsilon}{\varepsilon-1}\right)w\right)^{1-\varepsilon}\int_0^{a_D} a^{1-\varepsilon}\ dG(a)$$

(9)

$$v_A = N_A\ \beta\ E\ P^{\varepsilon-1}\left(\left(\frac{\varepsilon}{\varepsilon-1}\right)w\right)^{1-\varepsilon}\int_0^{a_A} a^{1-\varepsilon}\ dG(a)$$

(10)

Equations (11) and (12) add the assumption that the productivity of individual firms has a Pareto distribution with shape parameter k.

$$v_A = N_A\ \beta\ E\ P^{\varepsilon-1}\left(\left(\frac{\varepsilon}{\varepsilon-1}\right)w\right)^{1-\varepsilon}\left(\frac{k}{k-(\varepsilon-1)}\right)(a_A)^{k-(\varepsilon-1)}$$

(11)

[19] The model assumes that all firms face the same unit cost of inputs, since they all operate within the same country.

$$v_D = N_D\ \beta\ E\ P^{\varepsilon-1}\left(\left(\frac{\varepsilon}{\varepsilon-1}\right)w\right)^{1-\varepsilon}\left(\frac{k}{k-(\varepsilon-1)}\right)(a_D)^{k-(\varepsilon-1)}$$

(12)

Equations (11) and (12), along with the definition of h in equation (8), imply equation (13).

$$\frac{v_A}{v_D} = \frac{N_A}{N_D}\ (h)^{k-(\varepsilon-1)} = \frac{N_A}{N_D}\left(\frac{f_A}{f_D}\right)^{\frac{k-(\varepsilon-1)}{1-\varepsilon}}$$

(13)

The relative revenues of foreign and domestic firms are positively related to the relative number of potentially active firms, $\frac{N_A}{N_D}$, and negatively related to the relative fixed costs of participating in the national market, $\frac{f_A}{f_D}$. (This is the case as long as $\frac{k-(\varepsilon-1)}{1-\varepsilon} < 0$, the standard assumption in Melitz models with Pareto productivity distributions.)

The assumption that productivity levels are Pareto distributed with shape parameter k implies equations (14) and (15).

$$\frac{n_D}{N_D} = (a_D)^k$$

(14)

$$\frac{n_A}{N_A} = (a_A)^k$$

(15)

Equation (16) combines equations (14) and (15). For a given ratio of potentially active foreign and domestic firms, $\frac{N_A}{N_D}$, the ratio of active foreign firms to active domestic firms is decreasing in their relative fixed cost of participating in the national market, $\frac{f_A}{f_D}$.

$$\frac{n_A}{n_D} = \frac{N_A}{N_D}(h)^k = \frac{N_A}{N_D}\left(\frac{f_A}{f_D}\right)^{\frac{k}{1-\varepsilon}}$$

(16)

Equation (17) substitutes equation (16) into equation (13).

$$\frac{v_A}{v_D} = \left(\frac{n_A}{n_D}\right)\left(\frac{f_A}{f_D}\right)$$

(17)

Equation (17) relates the relative value of sales of the two types of firms (usually observable) to the relative number of active firms (usually observable) and the relative fixed costs of participating in the national market (usually not observable). Equation (18) rearranges equation (17). The ratio of sales per foreign firm to sales per domestic firm, which we call the relative scale of the foreign firms, is simply equal to the ratio of their fixed costs.

$$\frac{\left(\frac{v_A}{n_A}\right)}{\left(\frac{v_D}{n_D}\right)} = \frac{f_A}{f_D}$$

(18)

We can use the relative scale on the left-hand side of equation (18) to impute the ratio of fixed costs of participating in the national market on the right-hand side of the equation. The model implies that foreign firms will have larger scale in the national market than domestic firms if they face larger fixed

costs of participating in the market, and vice versa. It may seem counter-intuitive that larger costs could lead to larger scale, but it is a result of the zero-profit condition for market entry of the marginal firm at the cutoff: a firm facing a larger fixed cost will have to sell more in the market to break even.

If overhead costs are independent across national markets, with no multi-country economies of scale (as in Melitz models), then the ratio of the fixed costs of participating in the national market can serve as a measure of discriminatory costs or barriers to foreign firm participation in the market. In this case, we would expect that the ratio of foreign fixed costs to domestic fixed costs would be generally *greater than one*.

If firms entering overseas markets can leverage some of the overhead costs that they incur in their home markets, so that there are multi-country economies of scale, then the modeling framework could also explain cases where the ratio of foreign fixed costs to domestic fixed costs of participating in the national market is less than one. In these cases, however, the ratio no longer isolates and measures the discriminatory costs of barrier to foreign firm participation in the market.

The formula in equation (18) is especially convenient because it does not require estimates of the elasticity of substitution ε or the Pareto shape parameter k. These parameters can be very difficult to measure for specific industries.[20] The formula in equation (18) also does not require data on any of the other variables in the model, including total expenditure, prices, unit input costs, or the number of potentially active firms.

[20] di Giovanni, Levchenko, and Rancière (2011) represent perhaps the best attempt in the literature to estimate these parameters, but they do not provide estimates for the insurance services industry.

Appendix Tables

Table A1: Estimates based on OECD Data, Average Net Premiums (Million US Dollars)

National Market	Year	Average Net Premiums per Foreign Firm	Average Net Premiums per Domestic Firm	Average Net Premiums per Foreign Undertaking	Average Net Premiums per Foreign Branch
Argentina	2016	90.0	58.8	116.2	24.7
Australia	2016	172.1	699.1	325.4	50.2
Austria	2016	328.7	515.3	347.7	6.5
Brazil	2016	66.8	608.4	247.6	0.0
Canada	2015	147.6	575.1	242.6	113.4
Costa Rica	2016	11.9	412.6	13.0	6.9
Czech Republic	2016	107.6	27.1	237.6	15.5
Germany	2016	1156.5	646.5	1041.0	1965.0
Greece	2016	122.6	43.8	122.6	*
Honduras	2015	17.9	20.7	22.8	8.0
Italy	2016	312.4	1586.1	1043.8	4.7
Japan	2016	1245.7	6451.8	2056.2	570.3
Korea	2016	634.6	5291.8	1154.1	219.0
Latvia	2016	28.3	33.2	66.8	15.5
Lithuania	2016	38.7	5.1	57.3	27.9
Luxembourg	2016	45.0	147.8	47.7	2.7
Malaysia	2016	305.8	164.3	349.1	106.4
Norway	2015	149.7	222.7	402.3	109.6
Paraguay	2016	19.8	7.3	19.8	*
Portugal	2016	151.0	129.7	307.3	0.0
Russia	2016	56.3	56.5	88.3	0.8
Singapore	2016	117.5	291.7	98.6	144.9
Slovak Republic	2015	51.3	88.9	113.9	6.7
Spain	2015	336.0	233.5	346.2	0.0
Switzerland	2016	225.6	373.2	942.5	35.4
Turkey	2016	163.4	187.2	171.1	12.6
United Kingdom	2015	561.6	702.2	587.3	33.0
United States	2016	301.2	499.6	309.9	35.6
Uruguay	2015	31.8	204.6	31.8	*

Notes: cases with 0 premiums and 0 number of firms are denoted with "*." Data for 'foreign firms" reflect an aggregation of foreign undertakings and foreign branches.

Table A2: Estimates based on OECD Data, Implied Ratio of Fixed Costs

	Year	Implied Ratio of Fixed Costs Foreign/Domestic	Implied Ratio of Fixed Costs Foreign Undertaking/ Domestic	Implied Ratio of Fixed Costs Foreign Branch/Domestic
Argentina	2016	1.5	2.0	0.4
Australia	2016	0.2	0.5	0.1
Austria	2016	0.6	0.7	0.0
Brazil	2016	0.1	0.4	0.0
Canada	2015	0.3	0.4	0.2
Costa Rica	2016	0.0	0.0	0.0
Czech Republic	2016	4.0	8.8	0.6
Germany	2016	1.8	1.6	3.0
Greece	2016	2.8	2.8	n/a
Honduras	2015	0.9	1.1	0.4
Italy	2016	0.2	0.7	0.0
Japan	2016	0.2	0.3	0.1
Korea	2016	0.1	0.2	0.0
Latvia	2016	0.9	2.0	0.5
Lithuania	2016	7.5	11.2	5.4
Luxembourg	2016	0.3	0.3	0.0
Malaysia	2016	1.9	2.1	0.6
Norway	2015	0.7	1.8	0.5
Paraguay	2016	2.7	2.7	n/a
Portugal	2016	1.2	2.4	0.0
Russia	2016	1.0	1.6	0.0
Singapore	2016	0.4	0.3	0.5
Slovak Republic	2015	0.6	1.3	0.1
Spain	2015	1.4	1.5	0.0
Switzerland	2016	0.6	2.5	0.1
Turkey	2016	0.9	0.9	0.1
United Kingdom	2015	0.8	0.8	0.0
United States	2016	0.6	0.6	0.1
Uruguay	2015	0.2	0.2	n/a

Note: Data for 'foreign firms" reflect an aggregation of foreign undertakings and foreign branches.